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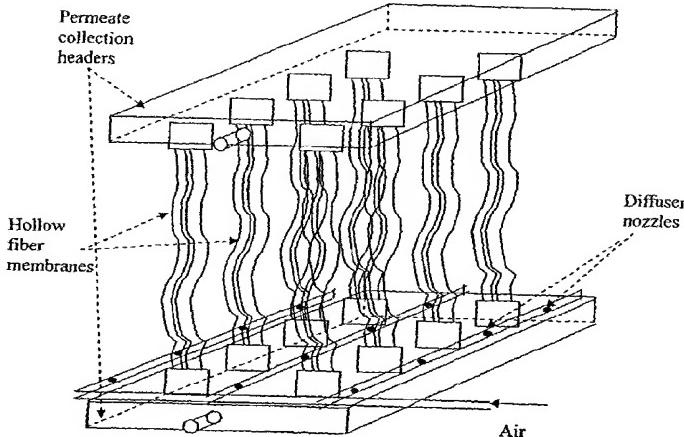
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(54) Title: METHODS FOR CLEANING AND MAINTAINING MEMBRANE SURFACE DURING FILTRATION



(57) Abstract: A method is provided for cleaning a membrane surface or maintaining a clean outside surface of a membrane during a process of outside-in membrane separation to remove suspended solids from a liquid phase. The method involves applying pressurized gas pulses to the membrane surface with individual pulse lengths of about 0.1 to 10 seconds. The pulses may be injected singularly with an interval of about 10 to 1000 seconds between pulses for a total duration of about 0.1 to 1000 hours. Alternatively, the pulses may be injected in clusters of about 2 to 100 pulses with an interval of 50 -300 % of the pulse length between individual pulses for a total duration of about 10 to 1000 seconds. In a preferred embodiment, both types of pulsation methods are combined in a particular sequence. The expanding gas directed toward the membrane surface in the course of one pulse dissipates energy of up to about 40 kJ/m³. One embodiment of the cleaning method involves backwashing the membrane with a permeate and applying the pressurized gas pulses during the filtration and/or backwashing steps of a filtration cycle.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

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A. CLASSIFICATION OF SUBJECT MATTER

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According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6 245 239 B1 (P.COTE ET AL) 12 June 2001 (2001-06-12) cited in the application claims	1-22
A	US 2002/153313 A1 (P.COTE) 24 October 2002 (2002-10-24) claims	1-22
A	WO 01/08789 A (ZENON ENVIRONMENTAL INC) 8 February 2001 (2001-02-08) claims	1,14,22
A	US 2001/027951 A1 (CH. GUNGERICH) 11 October 2001 (2001-10-11) claims 7-16	1-22
		-/-

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

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PCT/US 03/40950

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4 767 539 A (D.L.FORD) 30 August 1988 (1988-08-30) claims -----	1-22
A	US 6 159 373 A (TH. W. BECK ET AL) 12 December 2000 (2000-12-12) cited in the application claims -----	1-22
A	US 5 639 373 A (M.MAHENDRAN ET AL) 17 June 1997 (1997-06-17) cited in the application claims -----	1-22

INTERNATIONAL SEARCH REPORT

Intelli	Application No
PCT/US	U3/40950

Patent document cited in search report		Publication date		Patent family member(s)		Publication date
US 6245239	B1	12-06-2001		CA 2278085 A1 CA 2279766 A1 US 2002139748 A1 US 2003127389 A1 US 2004112831 A1 US 2004113293 A1 US 2001027950 A1 US 2001027951 A1 AT 264272 T AU 765966 B2 AU 6073899 A BR 9914376 A CA 2345682 A1 WO 0021890 A1 CZ 20011236 A3 DE 69916479 D1 EP 1445240 A1 EP 1452493 A1 EP 1119522 A1 HU 0103786 A2 JP 2002527229 T PL 347240 A1 TW 464532 B EG 22686 A US 6319411 B1		20-01-2001 30-01-2001 03-10-2002 10-07-2003 17-06-2004 17-06-2004 11-10-2001 11-10-2001 15-04-2004 09-10-2003 01-05-2000 07-08-2001 20-04-2000 20-04-2000 17-04-2002 19-05-2004 11-08-2004 01-09-2004 01-08-2001 28-01-2002 27-08-2002 25-03-2002 21-11-2001 30-06-2003 20-11-2001
US 2002153313	A1	24-10-2002		US 2002134740 A1		26-09-2002
WO 0108789	A	08-02-2001		CA 2279087 A1 US 6547968 B1 US 6303035 B1 AU 6257000 A AU 6419000 A WO 0108790 A1 WO 0108789 A2 US 2003146153 A1 US 2004007525 A1 US 2001052494 A1		29-01-2001 15-04-2003 16-10-2001 19-02-2001 19-02-2001 08-02-2001 08-02-2001 07-08-2003 15-01-2004 20-12-2001
US 2001027951	A1	11-10-2001		CA 2307492 A1 CA 2278085 A1 CA 2279766 A1 US 6319411 B1 US 6245239 B1 US 2002179517 A1 US 2004206683 A1 US 2004238432 A1 AT 264272 T AU 765966 B2 AU 6073899 A BR 9914376 A CA 2345682 A1 DE 69916479 D1 EG 22686 A EP 1119522 A1 HU 0103786 A2 JP 2002527229 T US 2002139748 A1		04-11-2001 20-01-2001 30-01-2001 20-11-2001 12-06-2001 05-12-2002 21-10-2004 02-12-2004 15-04-2004 09-10-2003 01-05-2000 07-08-2001 20-04-2000 19-05-2004 30-06-2003 01-08-2001 28-01-2002 27-08-2002 03-10-2002

INTERNATIONAL SEARCH REPORT

Intern: Application No
PCT/US 03/40950

Patent document cited in search report	Publication date		Patent family member(s)	Publication date
US 2001027951 A1			US 2003127389 A1 US 2004112831 A1 US 2004113293 A1 US 2001027950 A1 WO 0021890 A1 CZ 20011236 A3 EP 1445240 A1 EP 1452493 A1 PL 347240 A1 TW 464532 B	10-07-2003 17-06-2004 17-06-2004 11-10-2001 20-04-2000 17-04-2002 11-08-2004 01-09-2004 25-03-2002 21-11-2001
US 4767539 A	30-08-1988		AT 84243 T AU 563321 B2 AU 3440084 A WO 8501449 A1 DE 3486031 D1 EP 0160014 A1 JP 6059393 B JP 61500011 T	15-01-1993 02-07-1987 23-04-1985 11-04-1985 18-02-1993 06-11-1985 10-08-1994 09-01-1986
US 6159373 A	12-12-2000		AT 253973 T AU 686879 B2 AU 3466195 A WO 9607470 A1 CA 2199356 A1 CN 1159769 A ,B DE 69532129 D1 DE 69532129 T2 EP 0779835 A1 ES 2207654 T3 JP 10504996 T	15-11-2003 12-02-1998 27-03-1996 14-03-1996 14-03-1996 17-09-1997 18-12-2003 15-04-2004 25-06-1997 01-06-2004 19-05-1998
US 5639373 A	17-06-1997		AU 715364 B2 AU 6652896 A CA 2227692 A1 WO 9706880 A2 DE 1252921 T1 DE 03016134 T1 DE 29624446 U1 DE 29624447 U1 DE 29624474 U1 DE 69624492 D1 DE 69624492 T2 DE 69627397 D1 DE 69627397 T2 DE 69632422 D1 DE 69633806 D1 EG 21552 A EP 1170052 A1 EP 1213048 A1 EP 1252921 A2 EP 1369165 A1 EP 0846023 A2 US 5944997 A US 2002153299 A1 US 2003141248 A1 US 6042677 A US RE37549 E1	03-02-2000 12-03-1997 27-02-1997 27-02-1997 27-11-2003 19-05-2004 08-01-2004 08-01-2004 12-02-2004 28-11-2002 26-06-2003 15-05-2003 04-12-2003 09-06-2004 09-12-2004 31-12-2001 09-01-2002 12-06-2002 30-10-2002 10-12-2003 10-06-1998 31-08-1999 24-10-2002 31-07-2003 28-03-2000 19-02-2002

INTERNATIONAL SEARCH REPORT

Inte
Application No
PCT/US 03/40950

Patent document cited in search report	Publication date		Patent family member(s)	Publication date
US 5639373	A		US 2004035780 A1	26-02-2004
			US 2003164332 A1	04-09-2003
			US 6193890 B1	27-02-2001
			US 6294039 B1	25-09-2001
			US 2004118767 A1	24-06-2004
			US 5783083 A	21-07-1998
			US 2004182771 A1	23-09-2004
			US 2003136746 A1	24-07-2003
			US 2004238432 A1	02-12-2004
			US 5910250 A	08-06-1999